Studies on TiO_2 thin film deposited by spray pyrolysis technique for sensing Glucose

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Abstract - In this study, we report an effective glucose electrochemical biosensor using TiO_2 electrode. Glucose is an essential biomolecule for human beings. It serves as a source of energy for a living cell and a metabolic intermediate. TiO_2 thin film electrode was prepared by Spray pyrolysis technique. Cyclic voltammetry (CV) was used to analyse the performance of the TiO_2 as the electrochemical biosensor. TiO_2 electrochemical biosensor exhibits good sensitivity and high linearity for the detection of glucose.

Keywords: TiO_2 thin film, Spray pyrolysis technique, Cyclic voltammetry, Glucose sensor.

1. INTRODUCTION

Glucose, is a monosaccharide with a molecular formula $C_6H_{12}O_6$, is an essential biomolecule for human beings. It is also known as simple sugar or dextrose. Glucose in the blood and tissue fluids is drawn upon by all the cells of the body and used for the production of energy. The glucose found in bloodstream is referred to as blood sugar and its normal concentration is 80 to 120 mg/dL or 4.4 to 6.6 mM. Blood sugar level becomes much higher in persons suffering from diabetes mellitus. Thus detection of glucose is important in the areas of clinical diagnosis and treatment of diabetes [1].

There are several methods used for the analysis of blood glucose. They are optical, conductometric, refractometric, chromatography, amperometric, fluorometric, enzymatic method and electrochemical analysis [2-5]. In recent years the electrochemical analysis have gained attention in the investigation of important biological molecules and drugs because of their simplicity, cost effectiveness, easy handling and highly sensitive compared to other methods [6]. The objective of the work is to fabricate a metal oxide semiconductor electrode material for electrochemical biosensor to sense glucose.

Metal oxide semiconductor films have been widely studied and have received considerable attention in recent years, due to their optical and electrical properties. The metal oxide semiconductors such as TiO_2, ZnO, and SnO_2 are researched widely for various application such as optoelectronic devices, sensors, solar cells and soon. Among these semiconductors, TiO_2 thin films have many applications to engage in the field of sensors, antireflection coatings, solar cells, photo catalysts depend not only on its energy band structure but to a great extent on its crystal structure, crystallite size and morphology. Titaniumdioxide (TiO_2) is an n-type semi-conductor, which can be found in any of its three polymorphs: anatase, brookite, and rutile [7].

Environmental friendly TiO_2 thin films got interest in the field of biosensor due to its good biocompatibility, large surface area, immobilizing ability and good surface, structural, physical, chemical and optical properties. The immobilizing amount of enzymes, activity of immobilized enzymes and conductivity are the key factors for the sensitivity of biosensors [8,9].

Semiconductors in the form of thin films got greater technological importance because of their variety of advantages over bulk crystals [10]. TiO_2 thin films were fabricated by many methods including molecular beam epitaxy, spin coating, electro deposition, RF-magnetron sputtering, pulsed laser deposition (PLD), metal– organic chemical vapour deposition (MOCVD) and spray pyrolysis.